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भारतीय मानक

तृण कटाई-कम्बाईन — परीक्षण संहिता

भाग 2 कार्यकारिता परीक्षण

Indian Standard

STRAW REAPER-COMBINE — TEST CODE

PART 2 PERFORMANCE TESTS

ICS 65.060.50

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

April 2008

Price Group 5

Farm Implements and Machinery Sectional Committee, FAD 21

FOREWORD

This Indian Standard (Part 2) was adopted by the Bureau of Indian Standards, after the draft finalized by the Farm Implements and Machinery Sectional Committee had been approved by the Food and Agriculture Division Council.

Straw reaper-combine, commonly known as straw combine, is being increasingly used, for threshing of straw of various cereal crops grown in the country. As a result of its increasing use, the need for standardized tests for helping the testing authorities for the assessment of the performance of the straw reaper-combine on uniform and rationalized basis was felt. This test code is expected to fulfil this long-felt need.

This standard has been published in two parts. While Part 1 covers the terminology, this part (Part 2) covers the method of various tests to be conducted to assess the performance of the straw reaper-combine.

In the formulation of this standard, considerable assistance has been derived from Northern Region Farm Machinery Training and Testing Institute, Hissar and Central Farm Machinery Training and Testing Institute, Budni.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

STRAW REAPER-COMBINE —
TEST CODE

PART 2 PERFORMANCE TESTS

1 SCOPE

This standard (Part 2) covers the method of performance testing of straw reaper-combine.

2 REFERENCES

The following standards contain provisions, which through reference in this text constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
4905 : 1968	Methods for random sampling
15805 (Part 1): 2008	Straw reaper-combine — Test code: Part 1 Terminology

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 15805 (Part 1) shall apply.

4 SAMPLING AND GENERAL GUIDELINES

4.1 Sampling

The straw reaper-combine shall either be selected at random (*see* IS 4905) from the production lot by the testing station for commercial test or shall be submitted by the applicant to the testing authority for initial commercial test with the conditions to be incorporated in running format. The straw reaper-combine selected or submitted for test shall be complete with its usual accessories and in a condition generally offered for sale. The straw reaper-combine shall be new and shall not be given any special treatment or preparation for test. The method of selection shall be stated in test report.

4.2 Specification Sheet

The applicant shall supply the specifications of the straw reaper-combine consisting of the items listed in the specimen report given in Annex A as well as any other data required to carry out the tests. The manufacturers shall also supply all literature consisting of operation, maintenance, service and parts catalogue, normally supplied along with the machine.

4.3 Fuel and Lubricants

The fuel and lubricant for prime-mover and machine shall be selected from the range of products commercially available but shall conform to the minimum specifications applicable. The fuels and lubricants shall be identified in the following manner:

a) *Fuels* — Brand name, type and grade, density at 15°C; and
b) *Lubricants* — Type and viscosity. If different lubricants are used, precise information shall be given as to where they are applied.

4.3.1 In test report the type and grade of lubricant used in various assemblies shall be specified in a tabular form giving recommendation of the manufacturer (as specified in printed literature) and as used at the testing station (*see* Table 1).

Table 1 Specifications of the Fuel and Lubricant Used in Different Components

Sl No. (1)	Name of the Component (2)	Fuel/Lubricant Specified by Manufacturer (3)	Period of Oil Change (4)	Used for Testing (5)	Quantity ml (6)
i)					
ii)					
iii)					
iv)					

4.3.2 *The Oil Change*

Over period as given in the printed literature shall be followed at the testing station and deviations, if any, shall be specified in the test report.

4.4 Running-in

The straw reaper-combine shall be run-in at the testing station by the applicant in collaboration with the testing station, before the start of test, under his responsibility and in accordance with usual instructions. If this procedure becomes impracticable for any reason, the testing station shall run-in the straw reaper-combine provided that the authority of the applicant or his representative, who will remain responsible for running-in is obtained.

4.4.1 The duration of running-in and place shall be reported in test report.

4.5 Repair and Adjustment During Test

The applicant, during the course of test shall not make or introduce any major alterations or modifications which may affect the normal performance. However, normal operational adjustments can be made during the test. In case of straw reaper-combine submitted for confidential test, the testing authority at its discretion can permit major alterations or modifications on the request of the applicant. Any repair or adjustment during test can be recorded in Table 2.

Table 2 Repair and Adjustments Done During Testing

Sl No.	Duration of Running	Defect/ Breakage	Major/ Minor	Repaired/ Not Repaired	Duration for Repair	Possible Cause of Defect
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)						
ii)						
iii)						
iv)						

4.6 The conditions for checking of dimensions:

a) The straw reaper-combine shall be parked on a firm level and horizontal surface;

b) The straw reaper-combine shall be stationary with its wheel and component in position, as if the straw reaper-combine was travelling in a straight line; and

c) Measurement conditions for various dimensions and characteristics as stipulated in IS 15805 (Part 1) shall also be followed.

5 TESTS

The test given below shall be conducted in the laboratory as well as in the field.

5.1 Laboratory Tests

a) Checking of specifications,

b) Chemical analysis and hardness testing of critical components,

c) Visual observations and checking of provision for adjustment,

d) Turning space and turning circle, and

e) Checking of wear (dimensional and mass basis).

5.2 Field Test

a) Rate of work;

b) Quality of work:

   i) Straw recovery percentage,

   ii) Length of cut straw,

   iii) Split straw percentage, and

   iv) Grain recovery percentage.

c) Fuel consumption of prime-mover and adequacy of power;

d) Safety requirements;

e) Visual observations relating to ease of operation, adjustments, maintenance repair etc; and

f) Repairs/breakdowns for soundless defects of construction.

6 LABORATORY TESTS

6.1 Specification Checking

The specification of the straw reaper-combine given by the applicant shall be checked and reported in test report by the testing station. While checking the dimensions the conditions stipulated in **4.6** shall be followed (*see* Annex A).

6.2 Material Analysis

The hardness testing and chemical analysis of critical components, such as knife section, knife guard, cylinder and concave shall be made and reported in test report (*see* Tables 3 and 4).

Table 3 Data Sheet for Chemical Analysis of Critical Components Percentage of Composition of Different Components of Metals Parts of Straw Reaper-Combine

Sl No.	Critical Component	Chemical Composition				
		Carbon	Manganese	Phosphorus	Sulphur	Silicon
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Knife blade					
ii)	Knife guard					
iii)	Cylinder blade					
iv)	Concave blade					
v)	Serrated					
vi)	Counter serrated blade					
vii)	Feeder/beater					

6.3 Visual Observations and Checking of Provision for Adjustment

The straw reaper-combine shall be subjected to thorough inspection with particular attention to bearings, drives and other moving parts, correctness of various adjustments, tightness of bolts and nuts etc. The observation shall be reported in test report (*see* Table 5).

Table 4 Data Sheet for Constructional Material
(*Clause* 6.2)

Sl No. (1)	Component (2)	Material (3)	Hardness (4)
i)	Knife blade		
ii)	Knife guard		
iii)	Cylinder blades		
iv)	Concave blades		

Table 5 Data Sheet for Visual Observation and Checking of Provision for Adjustments
(*Clause* 6.3)

a) Observations:
  - i) Adequacy of marking on inlet and outlet
  - ii) Adequacy of marking of direction of rotations on threshing drum, blower unit, beater unit and reel unit
  - iii) Adequacy of protection of bearings against the ingress of dust
  - iv) Adequacy of safety covers especially at moving points
  - v) Provisions for lubrication of moving points
  - vi) Provisions for belts and chain tightening
  - vii) Provisions for transportation
  - viii) Provisions for trailer attachment
  - ix) Provisions for easy changing of components requiring frequent replacement (knife, blade, threshing blades, blower blades)
  - x) Provisions for easy replacement and cleaning of screens
  - xi) Provisions for anti-corrosive coatings
  - xii) Balancing of threshing unit
  - xiii) Proper registrations of cutter bar
  - xiv) Welding of seams
  - xv) Tightness of bolts and nuts and other fasteners
  - xvi) Any other observations

b) Provisions for Adjustments:
  - i) Concave clearance
  - ii) Speed
  - iii) Screen slope
  - iv) Sieve clearance
  - v) Air displacement
  - vi) For quality of straw (in terms of length and width)
  - vii) Speed of the cutter bar
  - viii) Displacement of reel with respect to cutter bar
  - ix) Speed of the reel
  - x) Stone trap mechanism
  - xi) Height of cut
  - xii) Any other adjustment

6.4 Turning Radius and Turning Space

The test shall be carried out with specified prime-mover, straw reaper-combine and standard straw storage trailer combination at a travel speed to avoid slippage/skidding.

6.5 Checking of Wear

The wear of blades of cutter bar, cylinder and concave on dimensional and weight basis shall be reported (*see* Table 6).

Table 6 Data Sheet for Percentage of Wear of Components

Date: No. of Machine Hours: Area Covered:

Sl No.	Component	Mass of Component Before Test		Mass of Component After Test		Percentage Wear By	
		Mass g	Length mm	Mass g	Length mm	Mass g	Length mm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)							
ii)							
iii)							
iv)							

7 FIELD TEST

7.1 Crop and Field Conditions

Following crop and field conditions must be recorded (*see* Table 7).

7.2 Performance Parameters

The straw reaper-combine shall be tested in field for minimum of 50 h for harvesting of wheat straw left over by the combine, to assess field performance of straw reaper-combine with regard to quality of work, rate of work, fuel consumption of prime-mover, safety and soundness of construction etc.

7.2.1 *Quality of Work of Straw Reaper-Combine*

It refers to average length of straw, split straw percentage, dust and awn percentage in the wheat straw produced by straw combine. For length of straw, take sample of 50/100 straw pieces coming out from the straw outlet and take the average length. For other quality parameters, take 5 to 10 samples of 10 g from straw outlet. Separate the unsplit *bhusa*, dust, awn and weigh it. Calculate the split percentage, dust and awn percentage.

7.3 Grain Recovery Percentage

It refers to the recovery of grain from the leftover wheat straw in field by straw reaper-combine. Mark 1 m^2 area

Table 7 Crop and Field Conditions

(*Clause* 7.1)

Variety ______________________________ Field Condition ______________________

Sl No.	Crop Conditions	1	2	3	4	5	Avg.	Sl No.	Field Conditions
1	Plant population, No./m^2							1	Type of soil
2	Available straw mass/unit area, kg/m^2							2	Topography
3	Straw mass density, kg/m^3							3	M.C. of soil (db)
4	Moisture content of straw, percent (db)							4	No. of bunds in the direction of harvesting
5	Percentage of loose straw/m^2							5	Height of bunds, mm
6	Height of stubble before and after harvest, mm							6	Frequency of bunds/100 m length (Both directions)

in field at 3 places. Collect the unthreshed grain (threshed grain lying onto ground not be included) and ears present in straw. Weigh it. After operation of straw reaper-combine again collect the grain and ear at 3 places after marking 1 m^2 area. Find the percentage of grain recovered by straw reaper-combine (*see* Table 8).

Table 8 Grain Recovery Percentage

Sl No.	Grain (Un-threshed) Ear-head Recovered Before Harvesting the Straw	Grain Left-Over After Harvesting of Straw	Grain Recovered (2-3)	Grain Recovery $\frac{4}{2}\times 100$
(1)	(2)	(3)	(4)	(5)
i)				
ii)				
iii)				

7.4 Rate of Work

Rate of work of straw reaper-combine consists of two main points: (a) Area covered per unit time, and (b) Straw recovery.

The time taken to cover a specified area should be net time, stoppage and breakdown time for any reason should not be added in net time. The stoppage, breakdown time and reason should be noted (*see* Tables 9 and 10).

To determine straw recovery mark 3 or 4 plots of 1 m^2 (This excludes the area containing loose straw) and harvest the straw manually and find the average weight/m^2. In order to include the loose straw mark 3 or 4 plots of 5 m run of the machine. Collect the loose straw and find the average weight per meter run of the machine. Multiply this by the total run of the machine in the given area to determine the total loose straw. In order to find the loose straw area/m^2 divide the total loose straw by the given area. Add straw recovered (excluding loose straw) and the loose straw/m^2 to determine the total straw available before harvesting (*see* Table 11).

7.5 Overlap Percentage

Run the machine for at least 3 consecutive runs. Measure the width of 3 consecutive runs. Find the average width of the machine. Find the theoretical width of the machine. The difference between theoretical width and average effective width will give the overlap (*see* Table 12).

7.6 Fuel Consumption

The fuel consumption of tractor to operate straw reaper-combine combination (reaper and tractor + trolly) should be recorded and expressed in terms of liters per tonne of straw (*see* Table 13).

7.7 Summary of Field Test

The performance tests conducted in the field must be summarized in the form of Table 14.

Remarks on adequacy of power and other handling characteristics during field operation:

a) Safety features;

b) Table listing visual observations;

c) Soundness of construction — Table of repairs/breakdowns/defects, etc.; and

d) Turning space and turning radius.

Table 9 Data Sheet for Field Testing of Straw Reaper-Combine

(*Clause* 7.4)

Fuel Consumption: Wheat Straw Recovered:

Sl No.	Variety	Field Area		Time of Start h	Time of Finish h	Run Time h	Remarks		Fuel Consumption (Litres)
		Length m	Width m				Stop Time h	Reason	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)									
ii)									
iii)									

Table 10 Data Sheet for Rate of Work

(*Clause* 7.4)

Average Speed of the Machine:

Sl No.	Crop Variety	Area m^2	Run Time H	Speed of Operation	Time for Covered Area (Including Stop) h	Field Capacity ha/h	Remarks	
							Stoppage Time h	Reason
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)								
ii)								
iii)								
iv)								
v)								
vi)								
vii)								
viii)								
ix)								
x)								

Table 11 Data Sheet for Straw Recovery

(*Clause* 7.4)

Sl No.	Crop Variety	Weight of Wheat Straw Recovered Manually (Stubbles only) g/m^2	Weight of Loose Straw in 1 m Length g/m	Weight of Loose Straw in 1 m^2 (4 × Total Straw Length in the Field/Area)	Weight of Wheat Straw (Stubbles + Loose) Before Harvesting (3+5)	Weight of Straw Recovered Before Harvesting/m^2	Straw Recovery (6-7)	Straw Recovery Percent $\frac{8}{6} \times 100$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)								
ii)								
iii)								
iv)								
v)								

Table 12 Data Sheet for Percent Overlapping

(*Clause* 7.5)

Sl No.	Crop Variety	Machine Width in Simple Runs (Theoretical) m	Machine Width in *n* Runs m	Effective Machine Width in One Run (4/*n*) m	Overlap (3-5) m	Overlap, Percent $\frac{6}{3} \times 100$
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)						
ii)						
iii)						
iv)						
v)						
vi)						

Table 13 Fuel Consumption and Straw Recovery Speed of the Machine

(*Clause* 7.6)

Sl No.	**Total Time** h	**Area Covered** ha	**Weight of Straw Recovered** Tonnes	**Fuel Consumption** l	**Fuel Consumption** l/h **(5/2)**	**Fuel Consumption** l/ha **(5/3)**	**Fuel Consumption** l/Tonne **(5/4)**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)							
ii)							
iii)							
iv)							

Table 14 Summary of Field Performance Test

(*Clause* 7.7)

Crop Variety	**Rate of Work**		**Fuel Consumption**			**Average Length of *Bhusa*** mm	**Straw Split Percent**	**Straw Recovery Percent**
	ha/h	h/ha	l/h	l/t	l/ha			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)								
ii)								
iii)								
iv)								
v)								

Remarks on adequacy of power and other handling characteristics during field operation:

a) Safety features,
b) Table listing visual observations,
c) Soundness of construction—Table of repairs/breakdowns/defects, etc.; and
d) Turning space and turning radius.

ANNEX A

(*Clauses* 4.2 *and* 6.1)

SPECIFICATIONS

(All dimensions in millimetres unless otherwise specified)

1. General:
   Name and address of manufacturer
   Make
   Model
   Serial number
   Type
   Year of manufacture
   Recommended power of tractor (HP)
2. Brief specifications of prime-mover to be used:
   Type
   Make and Model
   Chassis No.
   Serial No.
   Maximum PTO Power, kW(Ps)
3. Straw reaper-combine:
   Transport wheels
   Type
   No. and size
   Track width
   Recommended tyre pressure (kg/cm^2)

4. Drive shaft:
   Type
   Number of pieces
   Number of splines
   Outer dia and length of shaft, mm:
      a) Length and size of rectangular shaft
      b) Length and size of inserted rectangular shaft
      c) Maximum length of inserted shaft with spline flange
      d) Method of fixing of drive shaft to the flange
      e) Safety device, if any
5. Gear box:
   Dia. of splines
   Number of splines
   Gear ratio
   Oil capacity, litres
   Method of driving arrangement and location
6. Reel assembly:
   Type
   Number of tyne bars
   Dia of bars
   Type of tyne bars
   Dia of reel
   Width of reel
   No. of tynes on each bar and their spacing
   Maximum distance ahead of cutter bar
   Maximum distance ahead of cutter bar when the reel is in rearmost position
   Maximum vertical distance above the cutter bar point up to the outer bar of reel
   Maximum vertical distance above the cutter bar points from the center of the reel
   Maximum vertical distance below the cutter bar points
   Distance from cutter bar points to the front of feeding auger
   Arrangement for variation of angle of the tynes
   Arrangement for forward and backward movement of the reel
   Type of reel drive
   Safety device in reel drive
7. Cutter bar assembly:
   Cutting width
   Effective cutter bar width
   Knife stroke
   Number and spacing of knife guards
   Number and type of blades
   Type of ledger plates
   Details of the knife drive
   Arrangement for lifting of lodged crop
8. Feeding auger:
   Type
   Size of auger:
      a) Dia
      b) Width
   Safety device, if any
9. Details of scoop
   Number of scoops
   Number of scoops on each row
   Arrangement for adjusting the clearance of crop auger
10. Beater:
   Type

Width
Dia
Number of sections
Width of one section, mm
Location
Number and type of bearings

11. Threshing drum:
    Type
    Width
    Outside dia
    Number of bars
    Number of blades and their spacing on each bar
    Shape of blade
    Size of blade, mm
    Number and type of bearings
12. Baffle plate:
    Type
    Size of plate
    Location
    Method of fixing of plate to machine
13. Concave:
    Width of concave
    Peripheral length
    Concave area, m^2
    Type of concave
    Number of bars and rods
    Range of clearance:
      a) Front
      b) Rear
    Method of fixing of concave in place
    Method of adjusting the clearance between drum and concave
14. Cleaning sieve:
    Type
    Size of sieve
    Effective size of sieve
    Hole dia
    Number of holes per 100 cm^2
    Inclination towards the blower unit
    Method of fixing and location
15. Grain pan:
    Type
    Size of grain pan
    Size of unloading door
    Method of fixing and location
16. Straw blower:
    Number of blower
    Dia
    Effective width
    Number and type of blades
    Size of blade length × Width
    Type of drive
    Number and type of bearings
    Method of varying the blower speed
17. Straw outlet:
    Type

Outlet size
Height of outlet from top reference point of machine
Length of curved portion

18. Straw outlet extension:
    - Type
    - Dia
    - Length
19. Safety device provided on the machine
20. Total number of lubricating points:
    - Greasing
    - Oiling
    - Wheel bearing
21. Length of straw reaper-combine in transport position
22. Height of hitch in working position
23. Overall dimensions
    - Working position:
      - a) Length (drawbar hitch point to trailer hitch point)
      - b) Width
    - Height (from ground level to top of straw outlet)
    - Mass; kg
24. Turning radius and turning space:
    - Minimum radius of turning circle
    - LHS
    - RHS
    - Minimum radius and turning space
    - LHS
    - RHS
25. Hardness of blades, HB/HRC
    - Cutter bar:
      - Minimum
      - Maximum
    - Bruising cylinder:
      - Minimum
      - Maximum

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